

# **International Symposium on Room Acoustics**

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KOESTISC

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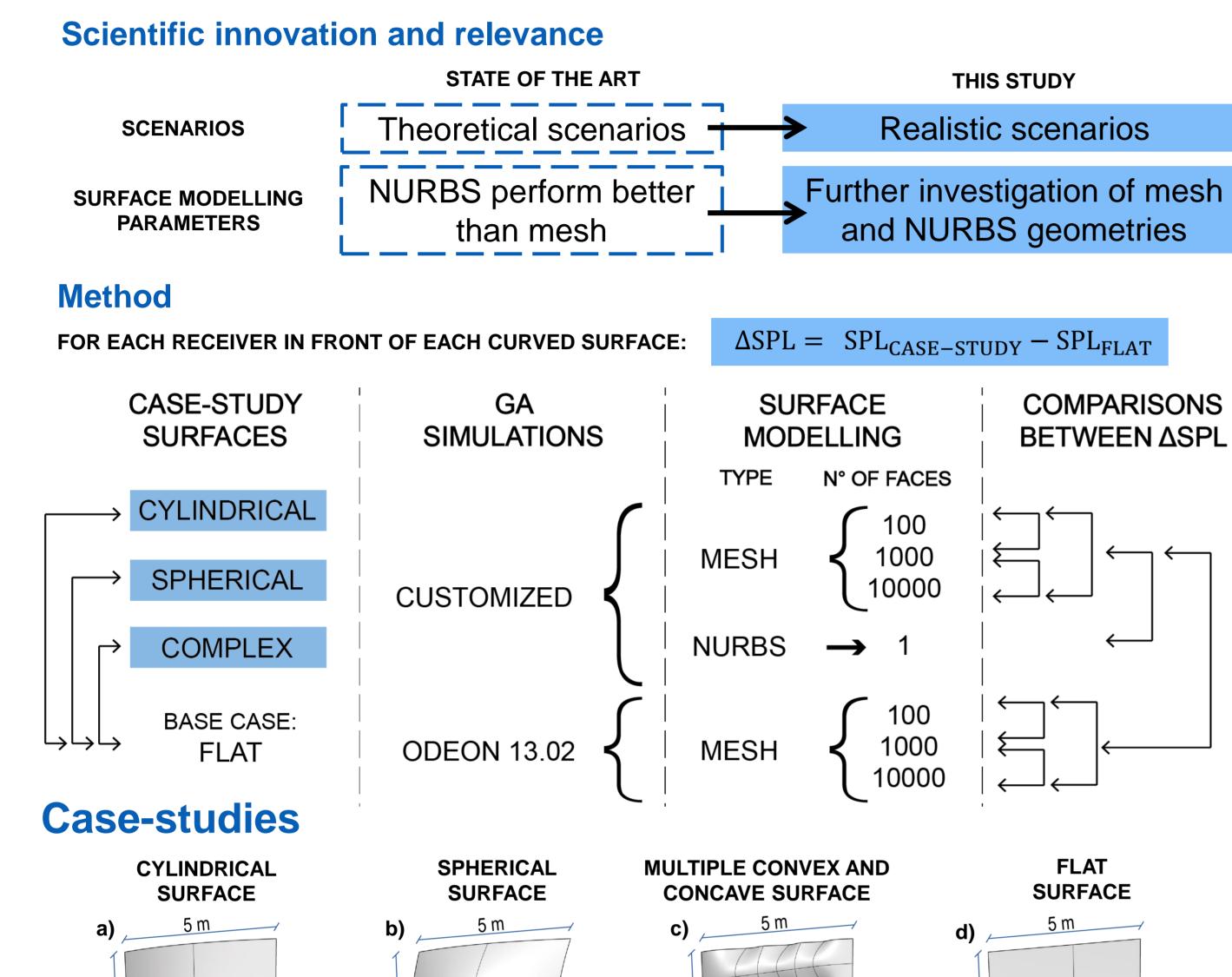
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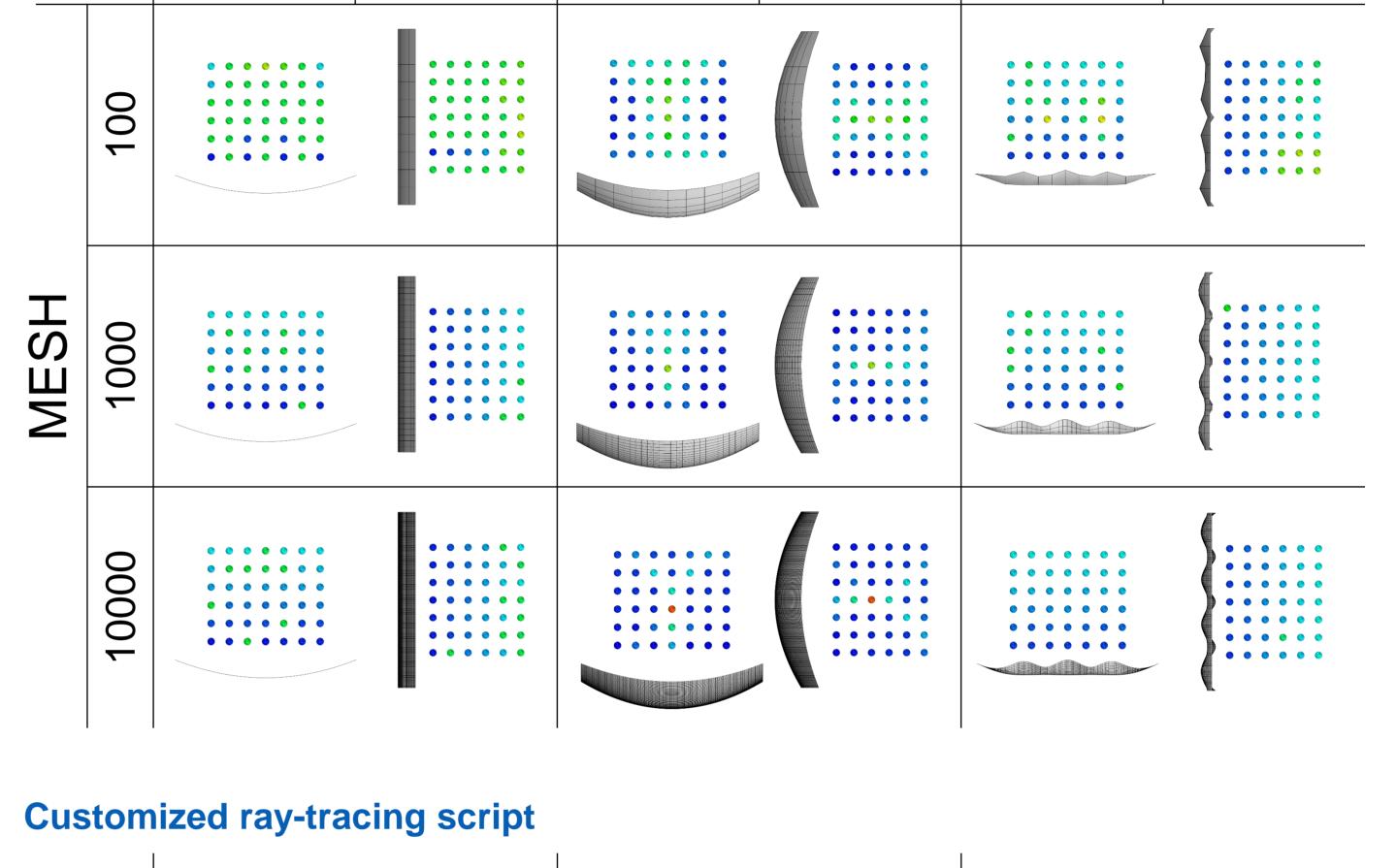
Outline of the work Research questions	
How should curved surfaces be modelled?	Comparison of SPL between Odeon 13.02 and customized ray-tracing scrip
Which is the difference between surface modelling parameters?	Comparison of mesh and NURBS geometry

## Results

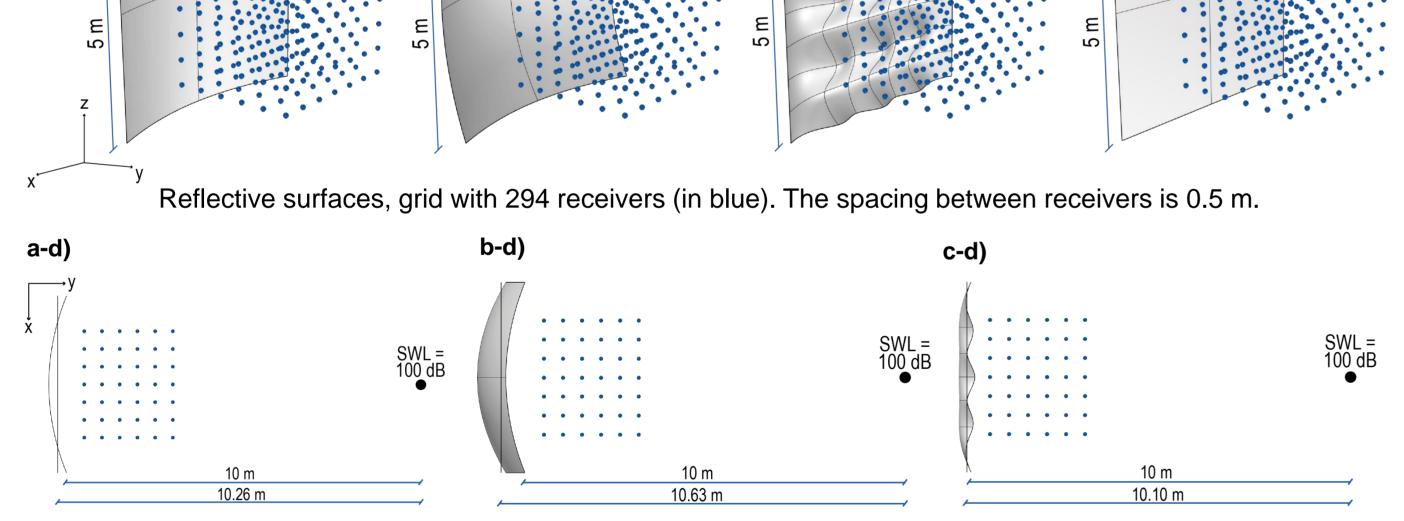
### Odeon 13.02

	CYLINDRICAL SURFACE		SPHERICAL SURFACE		MULTIPLE CONVEX AND CONCAVE SURFACE	
					-2.8 -1.8 -0.8 0.3 1.3 2.4 3.4 [dB]	
	XY PLANE	YZ PLANE	XY PLANE	YZ PLANE	XY PLANE	YZ PLANE





CYLINDRICAL SURFACE		SPHERICAL SURFACE		MULTIPLE CONVEX AND CONCAVE SURFACE	
-2.4 -1.5 -0.5 0.5	1.4 2.4 3.3 [dB]	-2.2 0.7 3.6 6.5	9.4 12.3 15.3 [dB]	-2.8 -1.8 -0.8 0.3	1.3 2.4 3.4 [dB]
XY PLANE	YZ PLANE	XY PLANE	YZ PLANE	XY PLANE	YZ PLANE
		• • • • • • • • • • • • • •		0 0 0 0 0 0 0 0 0 0 0 0	

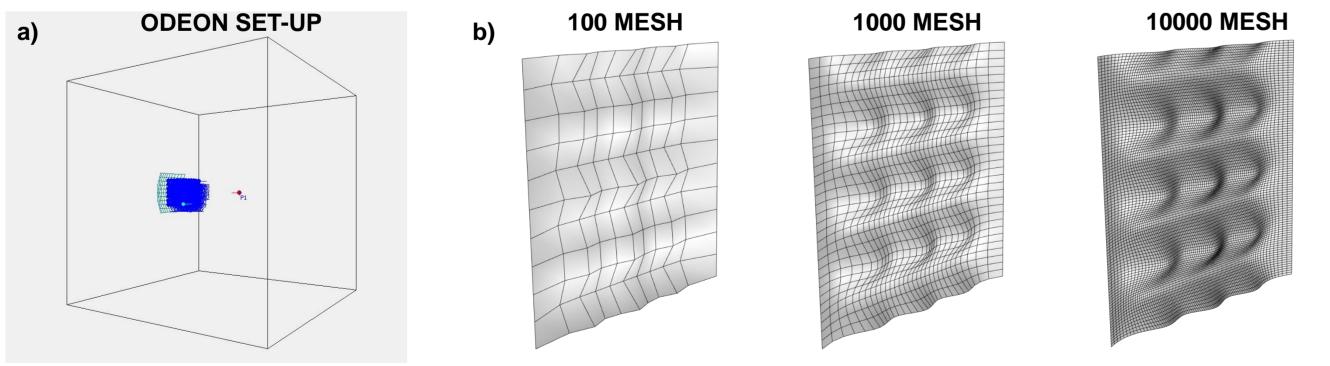


Curved and flat surfaces location with respect to the sound source and the receivers (in blue).

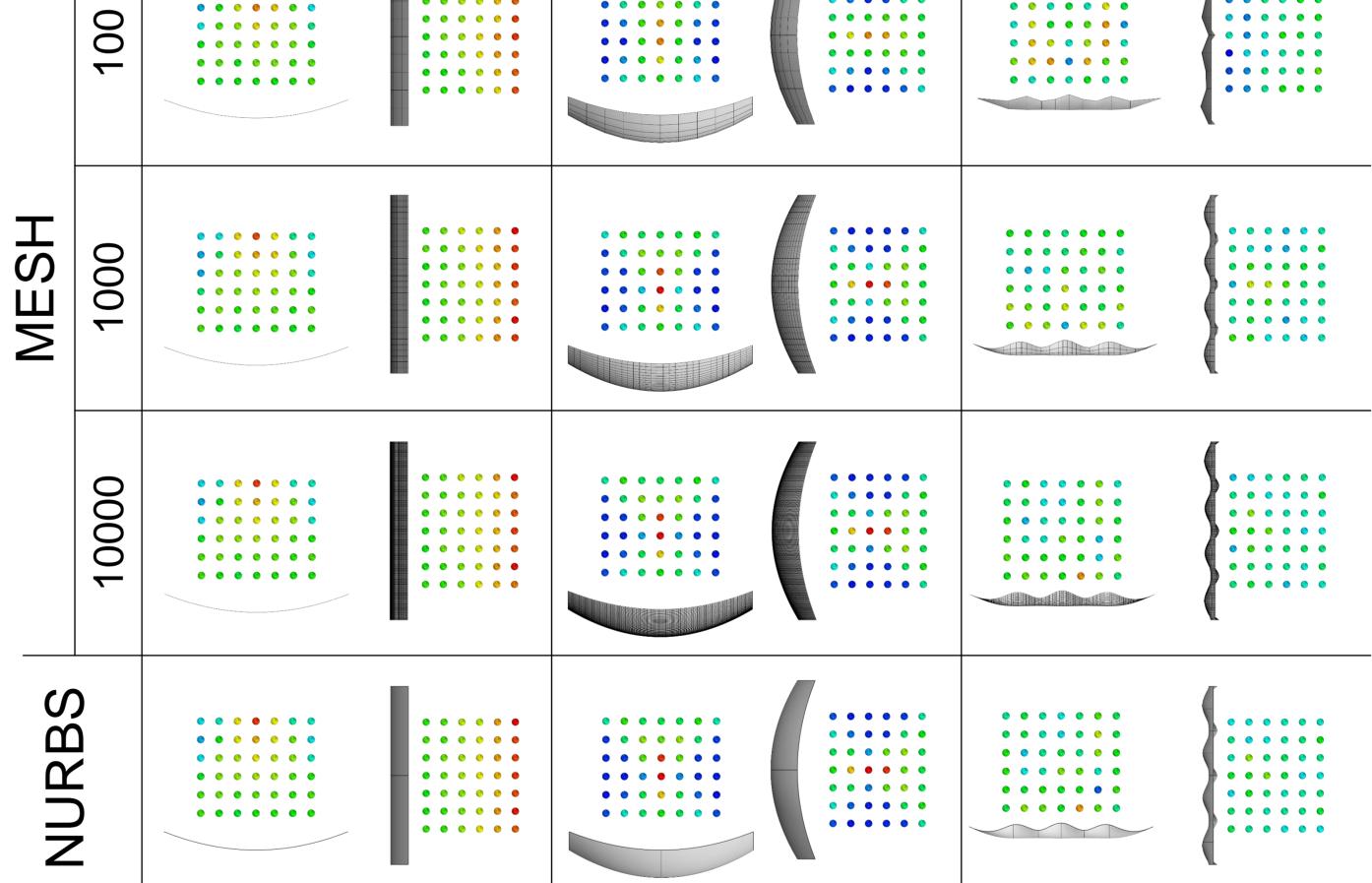
## **GA-based simulations**

#### **Odeon 13.02**

Mesh geometries with 100, 1000, 10000 faces. Number of rays: 30,000; Reflection-based scatter: disabled. Scattering coefficient: 0.05.



a) anechoic box enclosing the surface, source and receivers. b) multiple convex and concave surface discretized with 100, 1000 and 10000 faces.



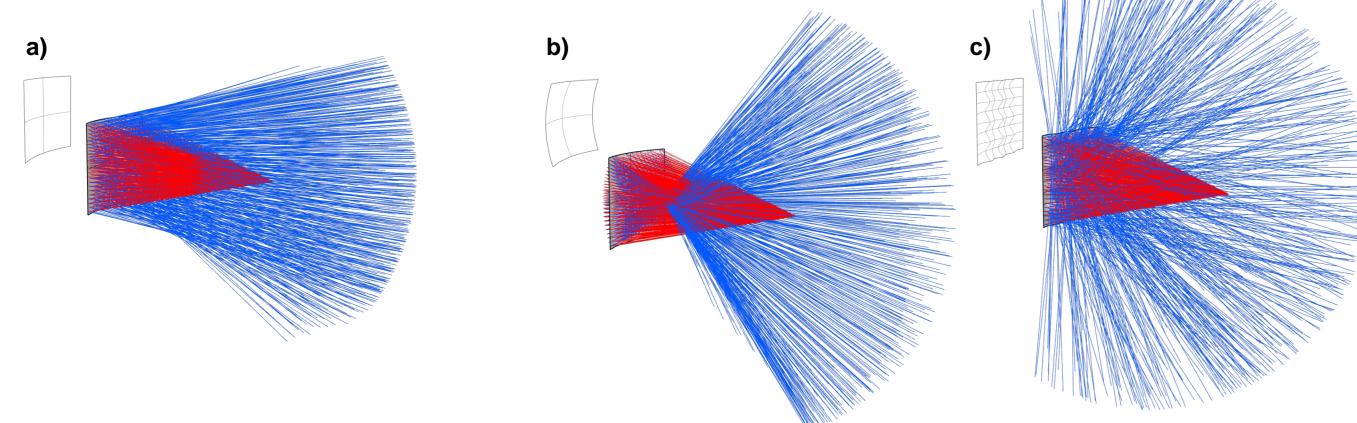
## **Conclusions**

In realistic scenarios with mesh geometries, SPL concentrations are more clearly evideced by the customized ray-tracer

Mesh discretizations of at least 1000 faces are required to achieve ΔSPL comparable to those obtained with NURBS geometries

## **Customized ray-tracing script**

Customized ray-tracing algorithm in Python, based on [6], implemented within Rhinoceros CAD environment. Mesh geometries with 100, 1000, 10000 faces + NURBS. Number of rays: 30,000.



Direct (red) and reflected (blue) rays for the cylindrical (a), spherical (b) and multiple convex and concave (c) NURBS surfaces.





#### Main references

- 1. Vercammen, M.: Sound Reflections from Concave Spherical Surfaces. Part I: Wave Field Approximation. Acta Acustica united with Acustica 96 (2010), 82 – 91.
- 2. Vercammen, M.: Sound Reflections from Concave Spherical Surfaces. Part II: Geometrical Acoustics and Engineering Approach. Acta Acustica united with Acustica 96 (2010), 92 – 101.
- 3. Kuttruff, H.: Some Remarks on the Simulation of Sound Reflection from Curved Walls. Acustica united with Acustica 77 (1992), 176 – 182.
- 4. Vercammen, M.: Sound Concentration Caused by curved Surfaces, PhD thesis, Eindhoven University of Technology, 2012.
- 5. Méndez Echenagucia, T. I., Astolfi, A., Sassone, M., Shtrepi, L., Van Der Harten, A.: NURBS and Mesh geometry in Room Acoustic Ray-tracing Simulation. Proc. International Conference on Acoustics AIA-DAGA. March 21-23, 2013, Merano (Italy), pp. 2083—2086.
- 6. Zeng X., Chen K., Sun J. On the accuracy of the ray-tracing algorithms based on various sound receiver models, Applied Acoustics 64 (2003), pp. 433-441.

